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(71) Applicant
Standard Telephones
and Cables Public
Limited Company,
(United Kingdom),
190 Strand,
London,
WC2R 1DU

(72) Inventors
Douglas Frank George
Dwyer,
John Mark Baker

(74) Agent and/or address for
service
M. C. Dennis,
STC Patent Office,
Edinburgh Way,
Harlow,
Essex,
CM20 2SH

(54) Voltage controlled oscillator

(57) A wide range voltage controlled oscillator arrangement has a VCO in which an n -stage switchable capacitor network provides a set of n overlapping frequency ranges and a variable capacitance responsive to a control signal (e.g. from a feedback loop filter) adjusts the VCO frequency

within each range. A window detector detects when the control signal exceeds upper or lower limits and increments/decrements an up/down counter in association with a clock. The counter contents are applied to a decoder to provide 1-out-of- n range selection signals to effect switching of the VCO capacitor network. Clock is inhibited when the control signal is within the prescribed limits.

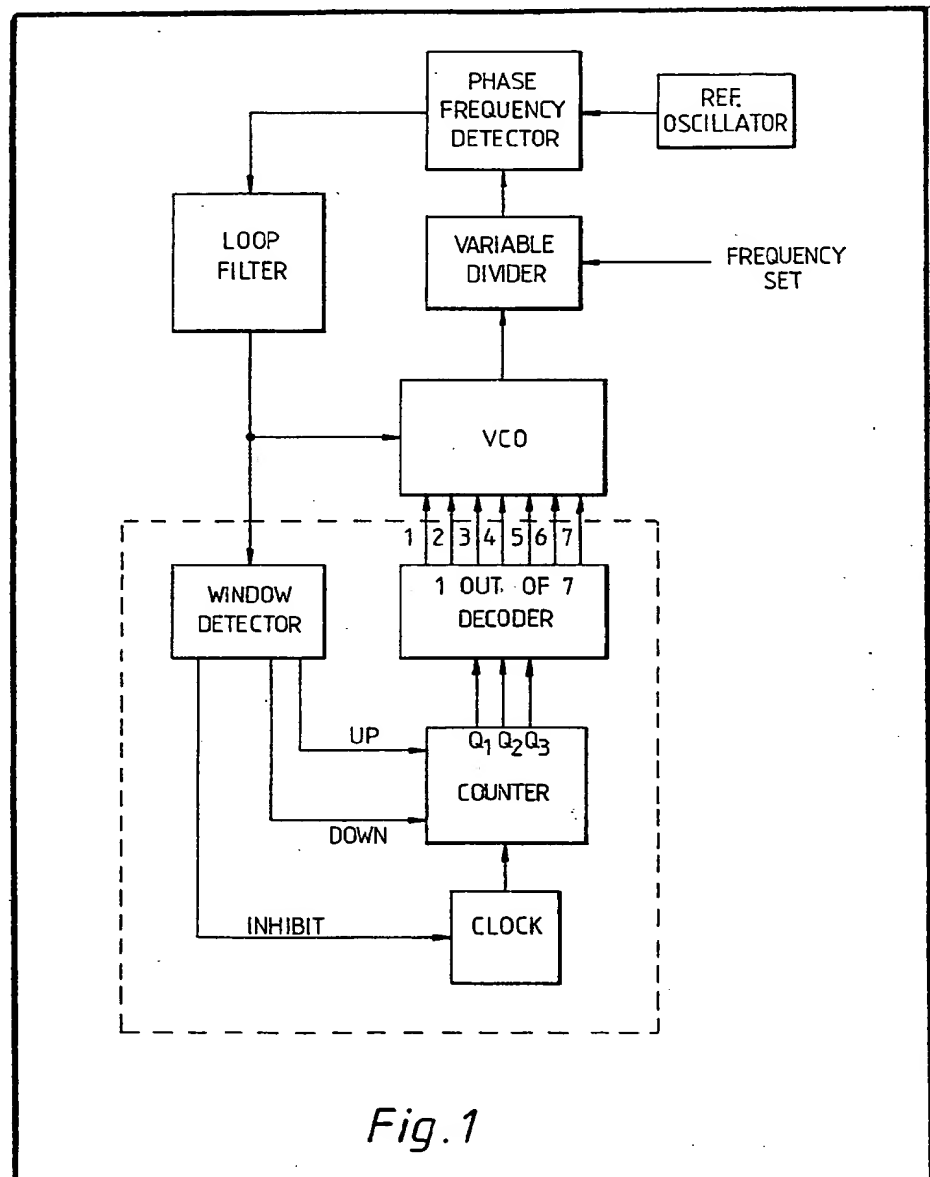
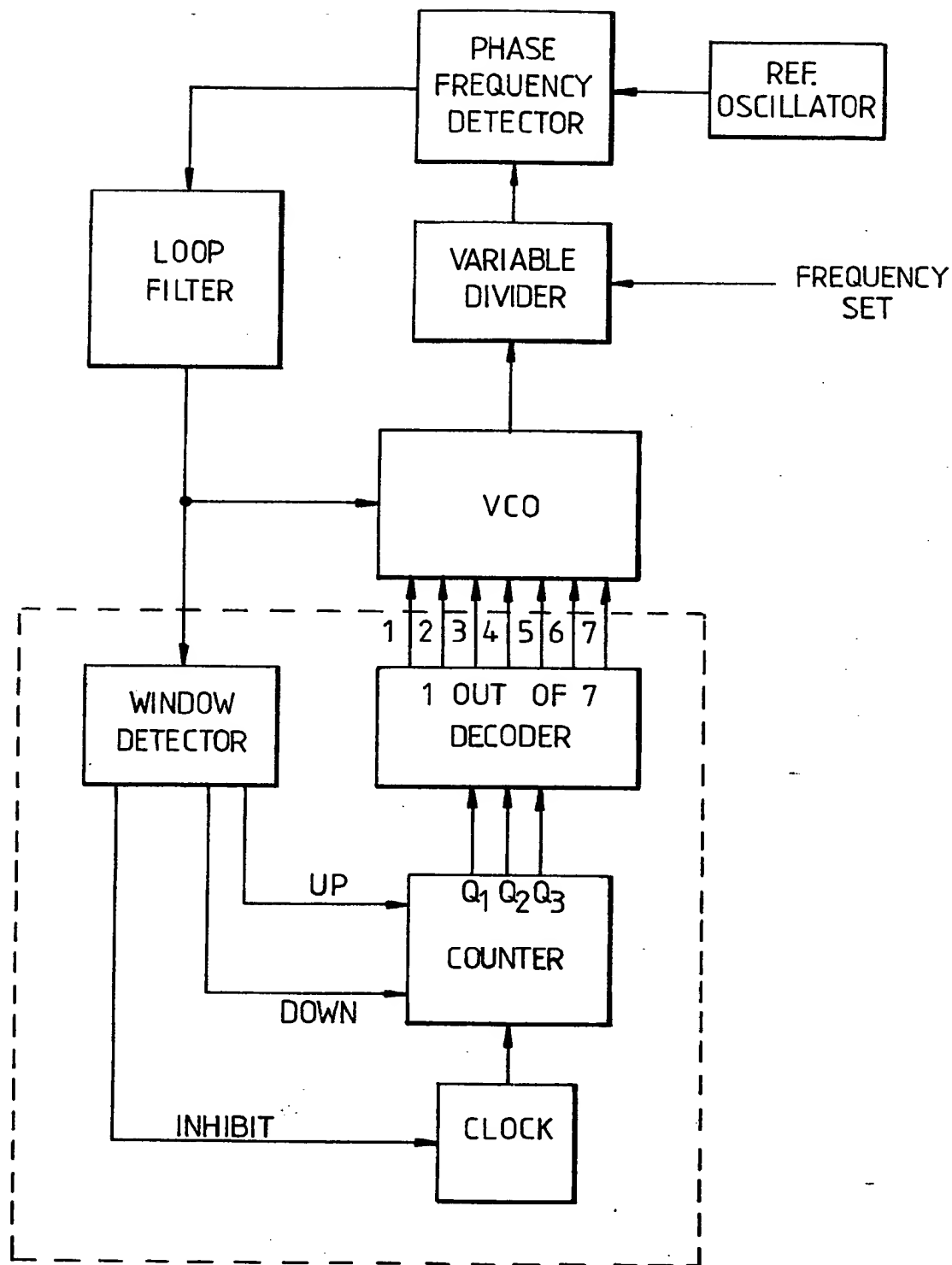


Fig. 1

The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy

$\frac{1}{3}$ *Fig. 1*

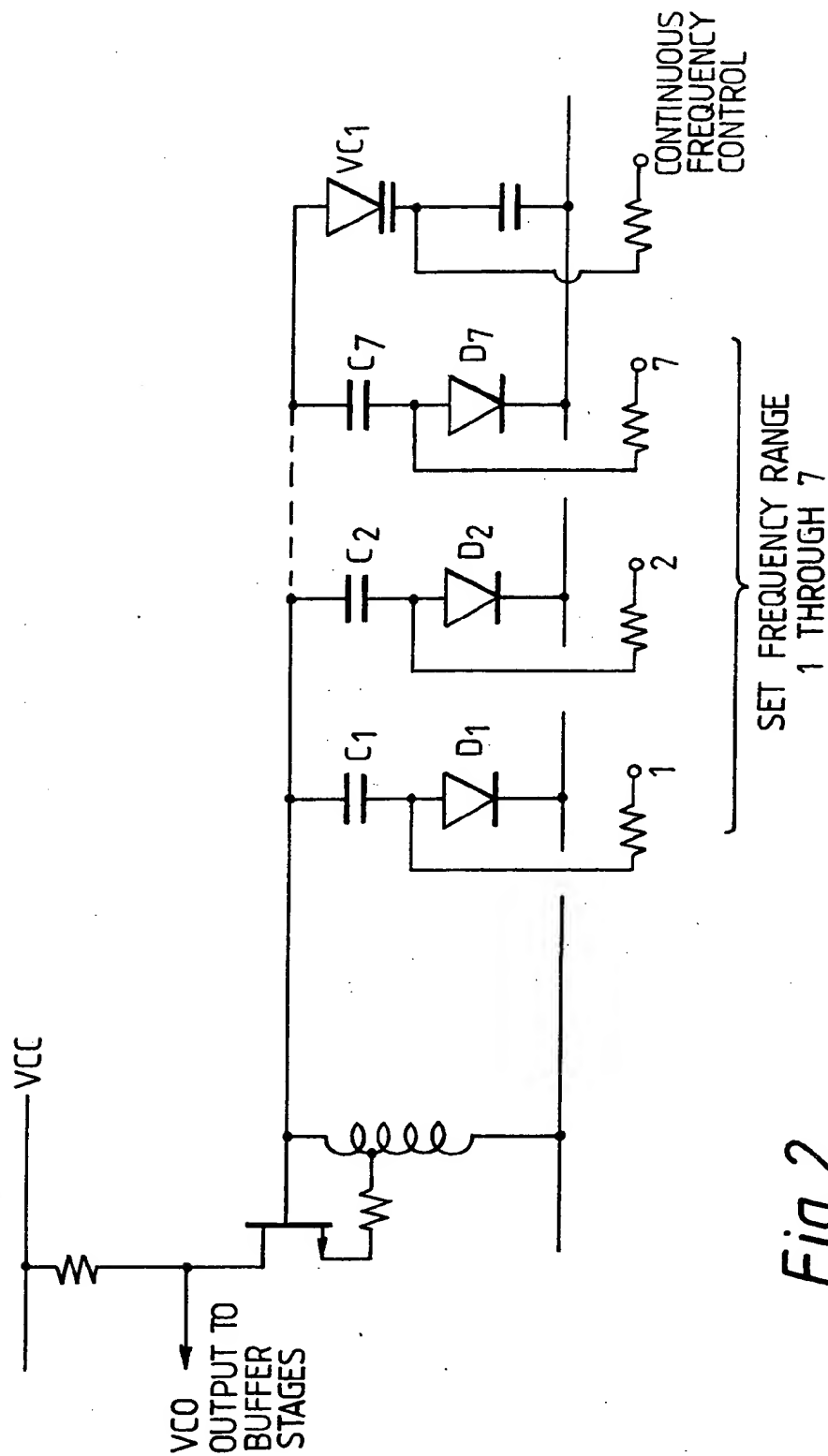
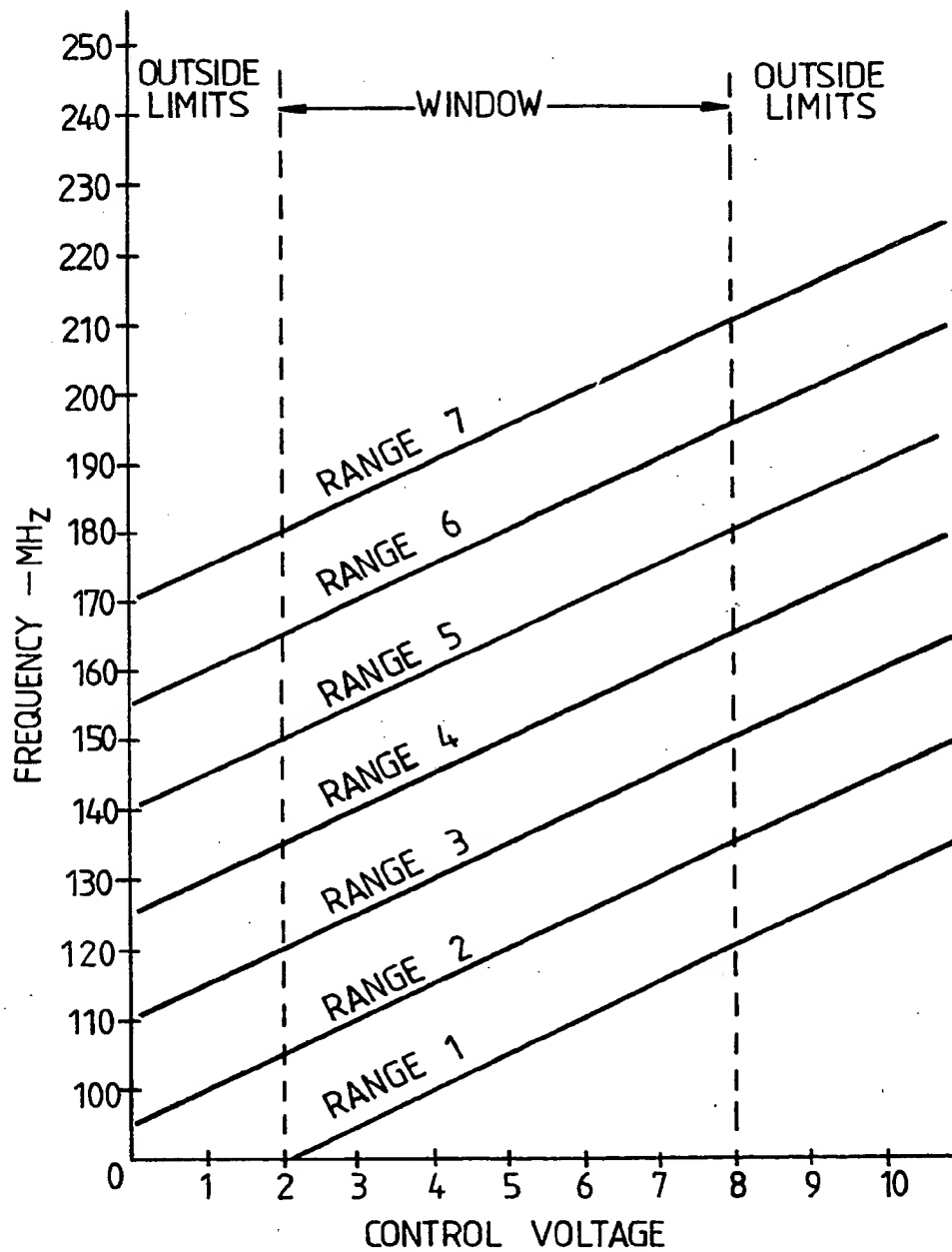


Fig.2

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Fig.3



SPECIFICATION

Voltage controlled oscillator

This invention relates to a voltage controlled oscillator, such as may be used in phase locked loop frequency synthesiser.

- A common form of phase locked loop frequency synthesiser compares the phase output of a voltage controlled oscillator (VCO) with that of a stable fixed frequency reference oscillator. The difference is fed back, through a loop filter, as a voltage control signal to the VCO. A variable frequency divider inserted in the output of the VCO is used to determine the frequency at which the VCO runs. Thus if the reference oscillator frequency runs at 1 KHz and the divider ratio is 10:1 the VCO output will be 1 MHz.

- To achieve a wide frequency range VCO it is known to use a switched capacitor network to provide stepped coarse frequency ranges. Thus in a wide range frequency synthesiser the operator has to set not only the variable divider ratio but also the appropriate VCO frequency range. Fine adjustment of the VCO frequency is then achieved by applying the loop control signal to a variable capacitor within the VCO.

- According to the present invention there is provided a voltage controlled oscillator arrangement which includes an n -stage switchable capacitor network to provide a set of n overlapping VCO frequency ranges and variable capacitance means responsive to a control to adjust the VCO frequency within each frequency range, means for detecting when said control signal exceeds a predetermined upper or lower limit, up/down digital counter means the status of which responds incrementally to output signals from said detecting means, decoding means for decoding the count in the counter means to provide 1-out-of- n range selection signals and switching means responsive to said selection signals to switch said capacitance network.

An embodiment of the invention will now be described with reference to the accompanying drawings, in which:—

- Fig. 1 illustrates in block diagram from a frequency synthesiser incorporating a wide range VCO,

Fig. 2 illustrates a range setting capacitor network for the VCO of Fig. 1, and

- Fig. 3 is a graphical illustration of the operation of the range setting network of Fig. 2.

- In the arrangement shown in Fig. 1 the output of voltage controlled oscillator 10 is fed via a variable divider 11 to a phase frequency detector 12 which also receives a reference frequency from reference oscillator 13. The detector output is fed back, via loop filter 14, as a control signal for the VCO. As shown in Fig. 2, the control voltage for the VCO is determined by a combination of a switched capacitance network C_1, C_2, \dots, C_7 with a variable capacitance VC_1 . The variable capacitance effects continuous frequency control over a limited range and the switched capacitances provide a series of overlapping

- 65 ranges within which the continuous frequency control is exercised. Fig. 3 illustrates an idealised set of frequency ranges plotted against variation in VCO control voltage.

- The variable capacitor VC_1 in the VCO is a varicap diode and is controlled by the loop filter signal. The loop filter signal is also applied to a "window" detector 15 which determines whether the loop filter output exceeds upper and lower control voltage limits. If the signal exceeds either limit an "up" or "down" signal is sent to a digital 3-stage counter 16. At the same time the window detector removes an inhibit control from a clock circuit 17 so that counter 16 can be incremented or decremented on the next clock pulse. The counter outputs Q_1, Q_2, Q_3 are fed to a 1-out-of-7 decoder 18. The selected decoder output is a voltage which switches the appropriate capacitor C_1, \dots, C_7 by way of an associated PIN diode D_1, \dots, D_7 . Thus the arrangement shown within the dotted line in Fig. 1 will cause the capacitance network in the VCO to be switched until the loop filter signal settles within the predetermined window, whereafter the VCO frequency is controlled solely by the variable capacitance. If now the variable divider 11 is set for a new synthesiser output frequency such that the loop filter signal moves out of the window then the counter and decoder arrangement will automatically select the correct range within which the new frequency is to be obtained.

Claims

1. A voltage controlled oscillator arrangement which includes an n -stage switchable capacitor network to provide a set of n overlapping VCO frequency ranges and variable capacitance means responsive to a control to adjust the VCO frequency within each frequency range, means for detecting when said control signal exceeds a predetermined upper or lower limit, up/down digital counter means the status of which responds incrementally to output signals from said detecting means, decoding means for decoding the count in the counter means to provide 1-out-of- n range selection signals and switching means responsive to said selection signals to switch said capacitance network.

2. An oscillator according to claim 1 wherein said switching means comprises a PIN diode in series with each capacitor, said diodes each being responsive to a respective range selection signal.

3. An oscillator according to claim 1 or 2 wherein said variable capacitance means is a varicap diode.

4. An oscillator according to any preceding claim including a source of clock pulses, said counter means being incremented when said clock pulses coincide with said output signals from said detecting means, and means for inhibiting the application of said clock pulses to said counter means in the absence of output signals from the detector means.

5. A voltage controlled oscillator arrangement

substantially as described with reference to the accompanying drawings.

6. A phase locked loop frequency synthesiser

including a voltage controlled oscillator according to any preceding claim.

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